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(71) Applicant(s)
Autoliv Development AB

(Incorporated in Sweden)

Patent Department, S-447 83 Vargarda, Sweden

(72) Inventor(s)
Per Olof Wernan
Jan-Erik Kallhammer
Thierry Contant

(74) Agent and/or Address for Service
Forrester Ketley & Co
Forrester House, 52 Bounds Green Road, LONDON, N11 2EY, United Kingdom

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B60R 21/16

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Online: WPI

(54) Airbag spiral folding

(57) A jig 10 or method for folding an airbag includes upper and lower jig assemblies each having a number of folding elements 15 that move towards one another from either side of the airbag to effect the folding and contact the airbag along a spiral line to create a spiral fold. The elements 15 may be arcuate and move through semi-circular spiral grooves 13, 14 within plates 11, 12. The folding elements may be moved sequentially into contact with opposite sides of the airbag along a spiral path beginning at the central region of the airbag to effect the folding. Alternatively the airbag may be placed between one folding element (22 figure 6) defining a spiral space and a second folding element (24 figure 6) comprising a spiral element which spiral element is introduced into the spiral space initially towards the inner region of the airbag and gradually towards the outer part of the airbag.

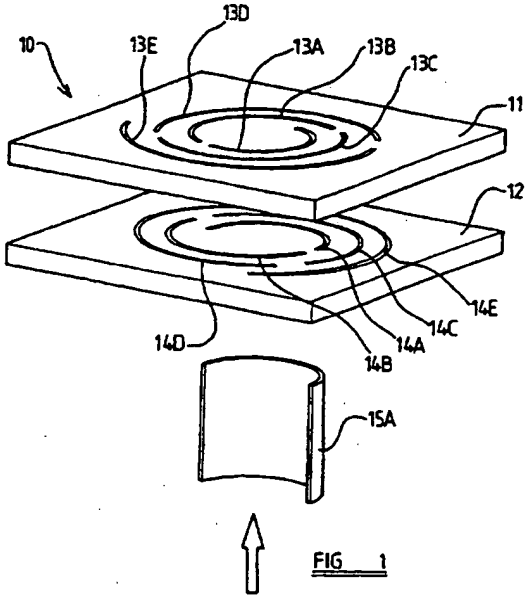

FIG 1

GB 2 315 050 A

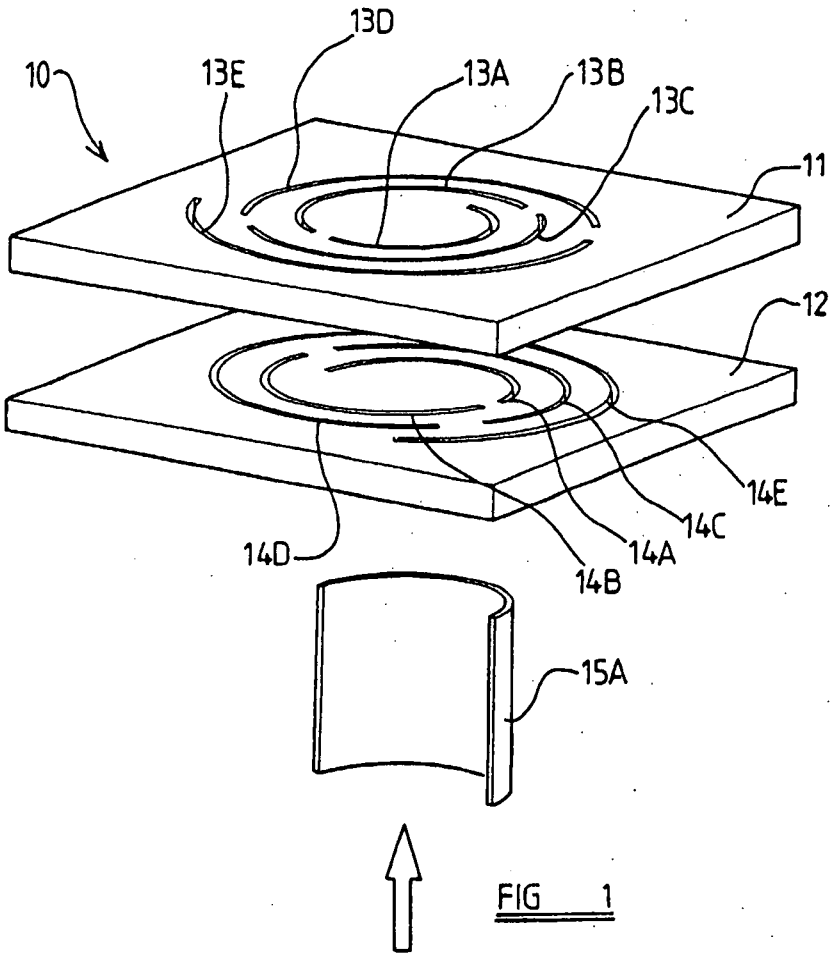
10
13D
13E
13A
13B
13C
11
12
14E
14C
14A
14B
14D
15A

FIG 1

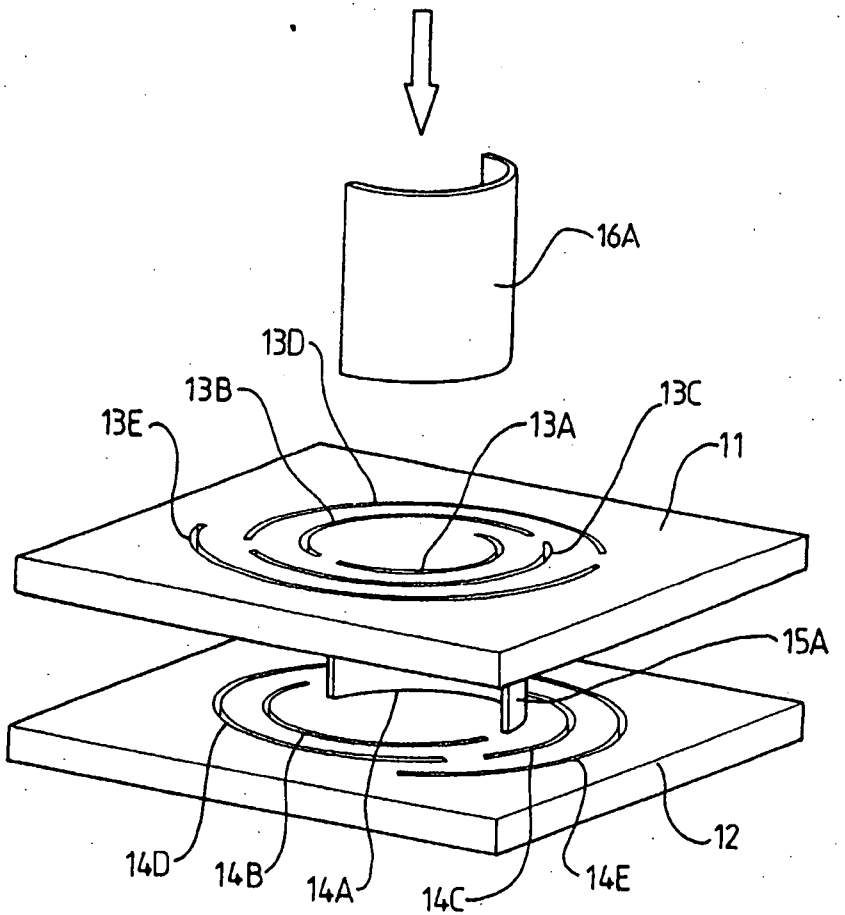
16A
13D
13B
13E
13A
13C
11
15A
14D
14B
14A
14C
14E
12

FIG 2

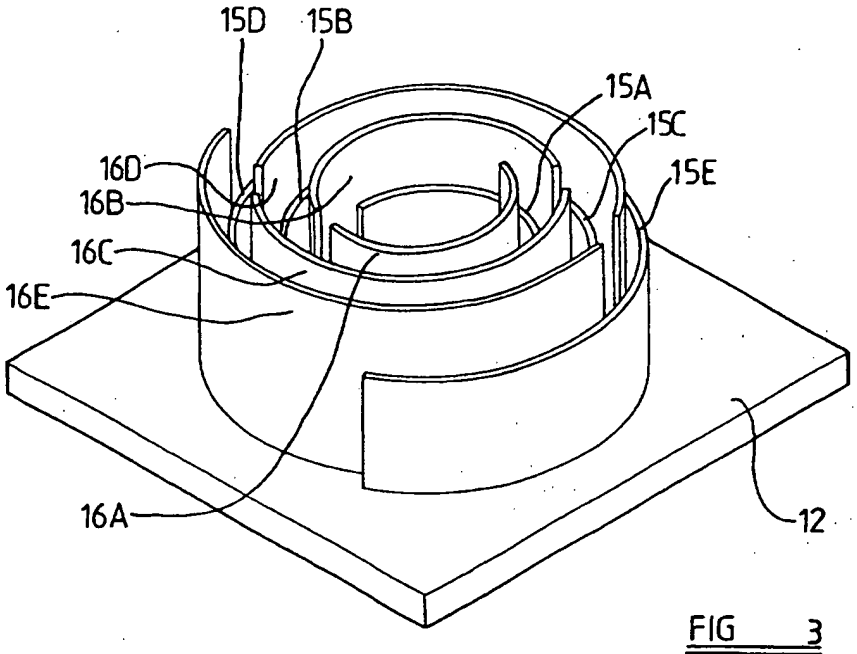
15D
15B
15A
15C
15E
16D
16B
16C
16E
16A
12

FIG 3

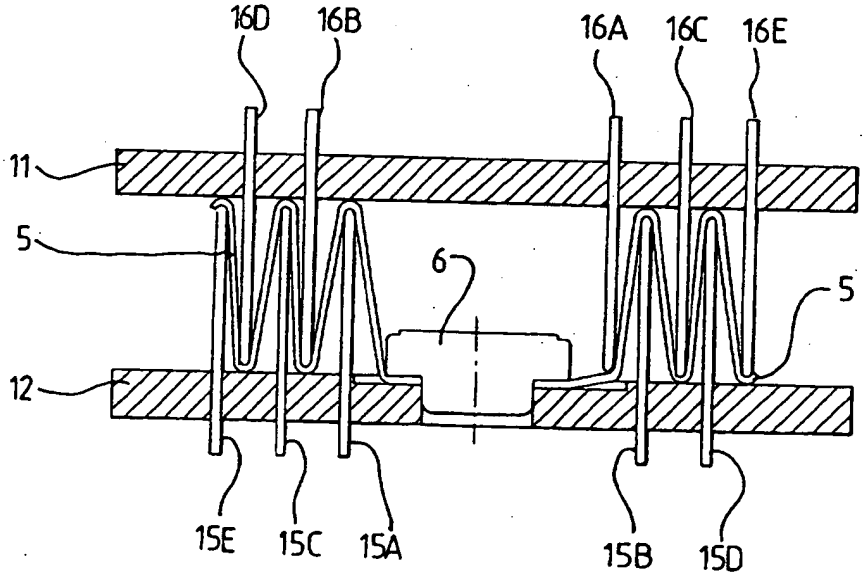
16D
16B
16A
16C
16E
11
5
6
5
12
15E
15C
15A
15B
15D

FIG 4

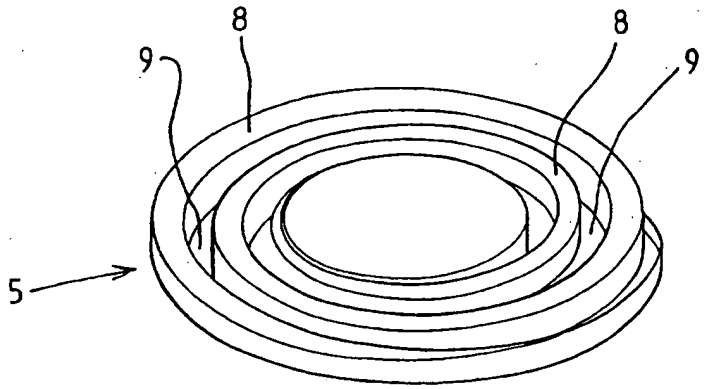

FIG 5

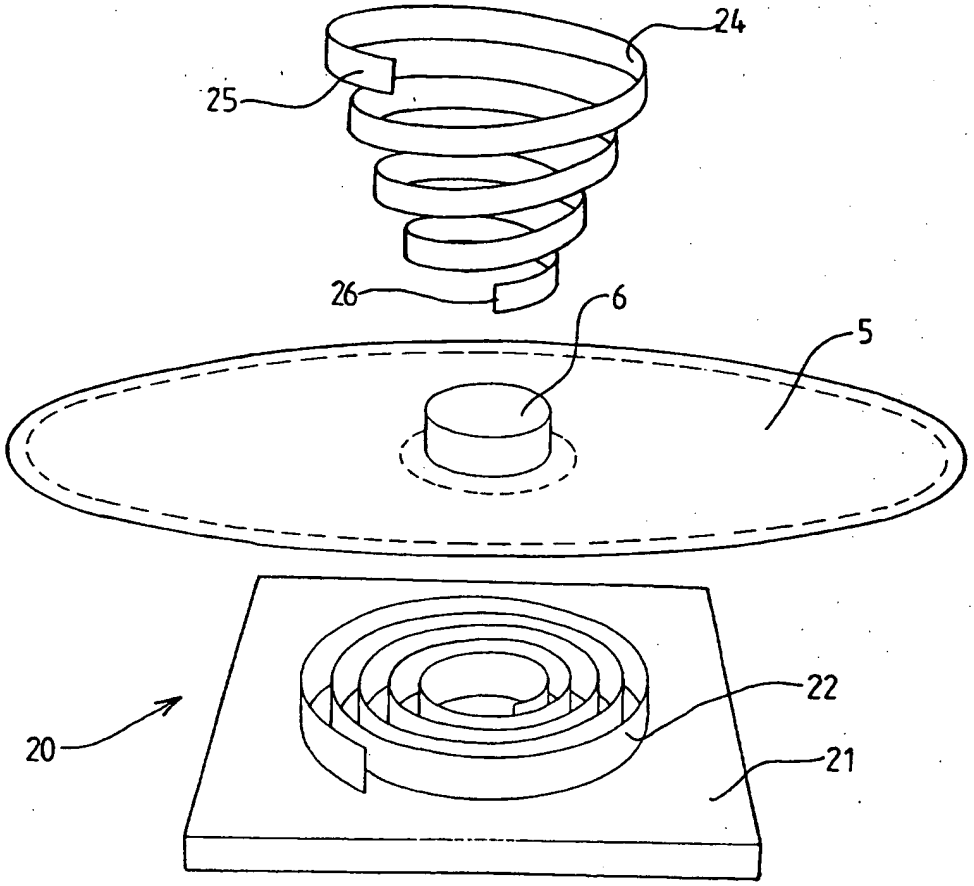

FIG 6

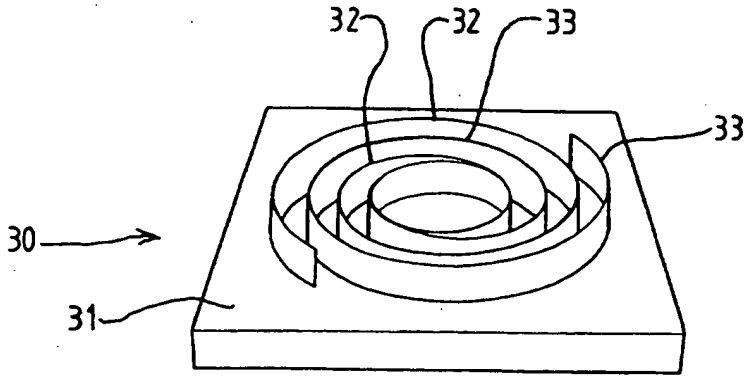

FIG 7

DESCRIPTION OF INVENTION

"IMPROVEMENTS IN OR RELATING TO AN AIR-BAG ARRANGEMENT"

THE INVENTION relates to an air-bag arrangement and more particularly relates to an air-bag arrangement intended for use in a motor vehicle.

It has been proposed to provide air-bags in motor vehicles adapted to be inflated in the event that an accident should occur, the inflated air-bag providing protection for the driver or other occupant of the vehicle. A typical air-bag is folded and stored in a housing. A gas generator is connected to a central part of the air-bag to supply gas to the air-bag. Such air-bags have to be deployed relatively swiftly in the event that an accident should occur, meaning that a large quantity of gas has to be generated swiftly and transferred to the interior of the air-bag, so that the air-bag will be inflated. The air-bag must inflate in a smooth un-impeded manner, and the initial folding of the air-bag may determine the manner of inflation of the air-bag.

A conventional method of folding an air-bag involves the location of an uninflated, flat and substantially circular air-bag between two folding elements. Each folding element comprises a series of equispaced concentric circular ridges. The ridges on the two folding elements are arranged such that the two folding elements can be brought together, the ridges of one folding element being received in the spaces between the ridges on

the other folding element and vice versa. As the folding elements are brought together, the air-bag conforms to the shape of the ridges on the folding elements thus providing the air-bag with a series of equispaced concentric circular folds. The spaces in the air-bag between the folds effectively comprise a series of annular compartments sealed by the folds.

When an air-bag folded in the above manner is inflated by a centrally located gas generator, the air-bag fills from the centre outwardly and as each fold is "opened" by the inflating gas, the next compartment is inflated. The result is an undesirable staged or jerky inflation which resists the deployment of the air-bag.

For optimum deployment of the air-bag, it is desirable that the air-bag should inflate as smoothly as possible.

According to this invention there is provided a jig for folding an air-bag, the jig comprising an upper assembly and a lower assembly, each assembly comprising one or more elements adapted to contact an air-bag to effect folding of the air-bag, the arrangement being such that the element or elements of each assembly may move towards each other to contact the air-bag along a notional spiral line, thus creating a spiral fold.

Relative movement of the element or elements of each assembly towards each other may be effected by moving the element or elements of the upper assembly downwardly towards the lower assembly or by moving the element or elements of the lower assembly upwardly towards the upper assembly or by moving the elements of each assembly simultaneously towards each other. It is appropriate for

any convenient technique to be used to effect the relative movement between the folding elements.

Preferably each assembly comprises a plurality of folding elements, the folding elements being individually movable relative to the respective assembly to a position in which each folding element contacts the air-bag.

Preferably the upper assembly comprises a first plate having one or more grooves spiralling outwardly from an inner region of the plate to an outer region of the plate, the groove or grooves receiving a first plurality of the folding elements, and a lower assembly comprising a second plate having one or more grooves spiralling outwardly from an inner region of the plate to an outer region of the plate, the groove or grooves receiving a second plurality of the folding elements, the plates being arranged to face one another, the folding elements each being dimensioned for projecting through the groove of the respective plate towards the opposite plate such that the folding elements of the respective plates can each project into spaces defined by the folding elements of the other plate, to create one or more peak fold lines and one or more trough fold lines spiralling outwardly from an inner region of an air-bag to an outer region of the air-bag.

Conveniently each plate has a plurality of discrete arcuate grooves, the grooves lying on a notional spiral line.

Advantageously each groove is substantially semi-circular.

Preferably a jig according to any one of the preceding Claims wherein the or each folding element comprises a substantially arcuate element.

Conveniently one assembly comprises a first plate having a folding element comprising means defining a substantially spiral space extending outwardly from an inner or central region to an outer region of the plate, and the other assembly carries a folding element int he form of a resilient spiral strip, the strip being dimensioned to be received within the spiral space, the strip being co-aligned with the space to be received within in the space, part of the strip which is located to be received in the part of the spiral space in the inner region of the plate being positioned to be received initially within the space, with the remainder of the strip being sequentially received within the space, with the part of the strip to be received in the radially outer-most part of the space being received finally within that space.

Preferably said other assembly comprises a plate, the plate being secured to the part of the spiral strip adapted to be received in the outer-most part of the spiral space, the remaining part of the strip depending freely.

Advantageously the first plate defines two or more spiral spaces, each spiral space being off-set relative to the other spiral space or spaces, the spiral spaces thus being nested, there being separate spiral strips which each act as a folding member carried by the other assembly, each separate spiral folding member being adapted to be received within a respective spiral space.

According to another aspect of this invention there is provided a method of folding an air-bag, said air-bag

having an outer region and an inner or central region, there being an inflation opening in the inner or central region defining an inlet for gas into the bag, the method comprising the steps of locating the bag in a substantially flat condition, effecting relative movement to folding elements to bring the elements into contact with opposed sides of the bag, the folding elements contacting each side of the bag along a notional spiral line to create a spiral fold, moving a first folding element to engage one side of the bag, moving a second folding element to contact the opposite side of the bag, and subsequently moving a third folding element to contact the first side of the bag, and a fourth folding element to contact the second side of the bag, and repeating the process with additional folding elements which alternately touch opposed sides of the bag.

The method may comprise the steps of moving a first folding element to engage one side of the bag, moving a second folding element to contact the opposite of the bag and subsequently moving a third folding element to contact the first side of the bag and a fourth folding element to contact the second side of the bag, and repeating the process with additional folding elements which alternately touch opposed sides of the bag.

Preferably each folding element is of arcuate form.

Advantageously each folding element is substantially semi-circular.

Preferably each folding element is individually movably received within a groove formed in a respective plate located adjacent the appropriate side of the bag.

In an alternative method a first folding element comprises means which define a spiral space and a second folding element comprises a member of spiral form, the method comprising the steps of introducing the spiral folding element into the spiral space, initially introducing part of the spiral folding element which is located towards an inner region of the plate into said space, and subsequently introducing the remaining parts of the said folding element into the space until finally a part of the spiral folding element located at an outer region of the space is inserted into the space.

FIGURE 1 is a perspective view of a jig according to one embodiment of the present invention being fitted with a first arcuate folding element,

FIGURE 2 is a perspective view of the jig of Figure 1 being fitted with another arcuate folding element,

FIGURE 3 is a perspective view of the jig of Figures 1 and 2 with all arcuate folding elements fitted, the air-bag and an upper plate of the jig not being shown,

FIGURE 4 is a cross-section through the jig of Figure 5 showing a folded air-bag,

FIGURE 5 is a perspective view of an air-bag embodying the present invention folded by the jig of Figure 3,

FIGURE 6 is a perspective exploded view of another jig for folding an air-bag in accordance with a further embodiment of the present invention, and

FIGURE 7 is a perspective view of a further jig embodying the present invention.

Figures 1 to 4 show a jig for producing a spirally folded air-bag. This jig 10 comprises two substantially identical assemblies, an upper assembly including plate 11 and a lower assembly including plate 12, each formed with a plurality of substantially semi-circular grooves 13,14 which are so located that the grooves substantially lie on a notional line which extends spirally outwardly from an inner region of the plates 11,12 to an outer region. Each groove 13,14 is substantially semi-circular in shape. The radius of the semi-circular grooves 13,14 increases from the inner region of the plates to the outer region of the plates.

In the example shown in Figures 1 to 4, the grooves 13,14 extend spirally in a clockwise direction (when viewed from above). The notional spiral line of the lower plate 12 is off-set by 90° relative to the notional spiral line of the upper plate 11 so that the spiral grooves 13 of the upper plate 11 start at a point which is approximately 90° off-set relative to the point of commencement of the grooves 14 in the lower plate 12. Thus, for example, if the innermost groove 13A of the upper plate 11 is considered to start in a North position, then the innermost groove 14A of the lower plate 12 starts in a West position. The following grooves of increasing diameter 13B, 14B, 13C, 14C, 13D, 14D, 13E, 14E are similarly off-set.

The grooves 13,14 each receive an arcuate and substantially semi-circular folding element 15,16. Each folding element may be slid individually through the respective groove from a retracted position, to an extended position in which the folding element projects from the

plate in which it is mounted towards the other plate. Since the grooves 13 on the upper plate 11 start approximately 90° off-set relative to the grooves 14 on the lower plate 12, the semi-circular folding elements 15,16, when received in their respective grooves, and moved to the extended position, on one plate 11,12 can project into spaces defined by the folding elements 16,15 on the opposite plate 12,11. This arrangement is best seen in Figure 3 in which the upper plate 11 is not shown so that the semi-circular folding elements 15,16 can be clearly seen.

In use, an uninflated air bag 5 is placed on the lower plate 12, the gas generator 6 being seated on an inner or central region of the plate 12. The upper plate 11 is brought down towards the lower plate 12 thereby sandwiching the air-bag 5. The upper and lower plates 11,12 remain spaced apart from one another as can best be seen in Figure 4. A first folding element 15A is pushed from below through the first groove 14A in the lower plate 12. A second folding element 16A is pushed from above through the first groove 15A in the upper plate 11. This process is continued by firstly pushing the next folding element 15B through the lower plate 12, then the next folding element 16B through the upper plate 11 and so on around the two spirals defined by the grooves 13,14. The folding elements of each plate contact the adjacent surface of the air-bag along a notional spiral line which commences in a central region of the air-bag adjacent the gas generator, and which terminates in an outer region of the bag. As each folding element 15,16 is pushed through its respective groove 14,13, the air-bag 5 conforms to the shape of the two sets of folding elements 15,16 to produce peak and trough fold lines 17,18 extending spirally outwardly from the gas generator 6, at an inner or central

region of the air-bag, to the periphery and outer region of the air-bag 5.

Figure 5 shows an air-bag 5 folded using the jig 10 shown in Figures 1 to 4. The jig 10 of Figures 1 to 4 produces a spiral fold.

Whilst the invention has been described with reference to an embodiment in which a plurality of grooves are provided in each plate which is on a notional spiral line, in an alternative embodiment, a single spiral groove may be provided which accommodate a plurality of folding elements adjacent one another.

When the air-bag 5 is fully wrapped around the gas generator 6, the air-bag 5 is then removed from the jig 10 and assembled in a housing for installation on a motor vehicle.

An air-bag folded in this manner overcomes the problems associated with concentrically folded air-bags which inflate in a staged or jerky fashion as the spiral fold pattern permits an uninterrupted flow of inflating gas from an inner region to an outer region of the air-bag.

A further jig 20 is shown in Figure 6 and comprises a plate 21 upon which is fixed a folding element in the form of a single ridge 22 extending spirally outwardly from an inner region of the plate 21 to the periphery of the plate 21, the ridge defining a spiral space which also extends outwardly from an inner or central region of the plate to an outer region of the plate. A gas generator 6 is seated at the centre of the plate 21 and an air-bag 5 is laid over the spiral ridge 22. Another plate 23 is provided (not shown) to which is attached a folding element

comprising resilient spiral strip 24 which acts as a folding member. The strip 24 is fixed to an outer region of the other plate at the radially outermost end 25 of the strip 24 such that the innermost end 26 of the spiral strip 24 is free and hangs down like a clock spring from the plate 23 (not shown). In this manner, the hanging strip 24 has a substantially conical envelope. The free end 26 of the spiral strip 24 is located adjacent the gas generator 6 and the two plates are pushed together. The free end 26 of the spiral strip is initially pushed into the spiral space defined by the ridge 22 in a part of the space in the inner region of the plate, thus commencing folding of the air-bag. As the plates move closer to each other, the remaining part of the spiral spring strip is gradually fed into the spiral space defined by the ridge 22. Finally the part of the spiral spring strip that is to be received in the space in the outer-most region of the plate is fed into the space. The air-bag is thus urged into the spiral space gradually by the spiral strip, and the air-bag is thus folded from the centre outwards as the spiral strip 24 progressively enters the space between the spiral ridge 22 on the plate 21. This arrangement thereby provides a progressive fold from the centre outwards, terminating at the outer-most region of the plate.

The numbers of ridges or walls on the plates and/or corresponding strips can be varied so as to provide as many fold lines as desired emanating from the gas generator 6 at the inner or central region of the air-bag to the outer region of the air-bag. In this regard, Figure 7 shows part of a jig 30 having a plate 31 formed with two outwardly spiralling ridges 32,33, which define two spiral spaces. The spiral spaces are angularly off-set relative to each other by 180° and the spiral spaces are thus nested within each other. A corresponding plate would also be provided

carrying two strips equivalent to the strips 24 described above. The strips would also be equally angularly off-set by an angle of 180° so that the strips are rested within each other. The jig would be used in the same way as the jig of Figure 6 to fold an air-bag and provide four fold lines - two peak fold lines and two trough fold lines.

CLAIMS:

1. A jig for folding an air-bag, the jig comprising an upper assembly and a lower assembly, each assembly comprising one or more elements adapted to contact an air-bag to effect folding of the air-bag, the arrangement being such that the element or elements of each assembly may move towards each other to contact the air-bag along a notional spiral line, thus creating a spiral fold.

2. A jig for folding an air-bag according to Claim 1, wherein each assembly comprises a plurality of folding elements, the folding elements being individually movable relative to the respective assembly to a position in which each folding element contacts the air-bag.

3. A jig for folding an air-bag according to Claim 2 wherein the upper assembly comprises a first plate having one or more grooves spiralling outwardly from an inner region of the plate to an outer region of the plate, the groove or grooves receiving a first plurality of the folding elements, and a lower assembly comprising a second plate having one or more grooves spiralling outwardly from an inner region of the plate to an outer region of the plate, the groove or grooves receiving a second plurality of the folding elements, the plates being arranged to face one another, the folding elements each being dimensioned for projecting through the groove of the respective plate towards the opposite plate such that the folding elements of the respective plates can each project into spaces defined by the folding elements of the other plate, to create one or more peak fold lines and one or more trough

fold lines spiralling outwardly from an inner region of an air-bag to an outer region of the air-bag.

4. A jig according to Claim 3 wherein each plate has a plurality of discrete arcuate grooves, the grooves lying on a notional spiral line.

5. A jig according to Claim 3 wherein each groove is substantially semi-circular.

6. A jig according to any one of the preceding Claims wherein the or each folding element comprises a substantially arcuate element.

7. A jig according to Claim 1 wherein one assembly comprises a first plate having a folding element comprising means defining a substantially spiral space extending outwardly from an inner or central region to an outer region of the plate, and the other assembly carries a folding element int he form of a resilient spiral strip, the strip being dimensioned to be received within the spiral space, the strip being co-aligned with the space to be received within in the space, part of the strip which is located to be received in the part of the spiral space in the inner region of the plate being positioned to be received initially within the space, with the remainder of the strip being sequentially received within the space, with the part of the strip to be received in the radially outer-most part of the space being received finally within that space.

8. A jig according to Claim 7 wherein said other assembly comprises a plate, the plate being secured to the part of the spiral strip adapted to be received in the

outer-most part of the spiral space, the remaining part of the strip depending freely.

9. A jig according to Claim 7 or 8 wherein the first plate defines two or more spiral spaces, each spiral space being off-set relative to the other spiral space or spaces, the spiral spaces thus being nested, there being separate spiral strips which each act as a folding member carried by the other assembly, each separate spiral folding member being adapted to be received within a respective spiral space.

10. A method of folding an air-bag, said air-bag having an outer region and an inner or central region, there being an inflation opening in the inner or central region defining an inlet for gas into the bag, the method comprising the steps of locating the bag in a substantially flat condition, effecting relative movement to folding elements to bring the elements into contact with opposed sides of the bag, the folding elements contacting each side of the bag along a notional spiral line to create a spiral fold, moving a first folding element to engage one side of the bag, moving a second folding element to contact the opposite side of the bag, and subsequently moving a third folding element to contact the first side of the bag, and a fourth folding element to contact the second side of the bag, and repeating the process with additional folding elements which alternately touch opposed sides of the bag.

11. A method according to Claim 10 comprising the steps of moving a first folding element to engage one side of the bag, moving a second folding element to contact the opposite of the bag and subsequently moving a third folding element to contact the first side of the bag and a fourth folding element to contact the second side of the bag, and

repeating the process with additional folding elements which alternately touch opposed sides of the bag.

12. A method according to Claim 11 wherein each folding element is of arcuate form.

13. A method according to Claim 12 where each folding element is substantially semi-circular.

14. A method according to any one of Claims 10 to 13 wherein each folding element is individually movably received within a groove formed in a respective plate located adjacent the appropriate side of the bag.

15. A method of folding an air-bag according to Claim 10 wherein a first folding element comprises means which define a spiral space and a second folding element comprises a member of spiral form, the method comprising the steps of introducing the spiral folding element into the spiral space, initially introducing part of the spiral folding element which is located towards an inner region of the plate into said space, and subsequently introducing the remaining parts of the said folding element into the space until finally a part of the spiral folding element located at an outer region of the space is inserted into the space.

16. A jig for folding an air-bag substantially as herein described with reference to and as shown in Figures 1 to 4.

17. A jig for folding an air-bag substantially as herein described with reference to and as shown in Figure 6.

18. A jig for folding an air-bag substantially as herein described with reference to and as shown in Figure 6 as modified by Figure 7 of the accompanying drawings.

19. A method for folding an air-bag substantially as herein described with reference to Figures 1 to 5.

20. A method of folding an air-bag substantially as herein described with reference to Figure 6.

21. Any novel feature or combination of features disclosed herein.

The Patent Office

Application N :	GB 9713958.8	**Examiner:**	Karl Whitfield
Claims searched:	1 to 15	**Date of search:**	16 September 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): B7B (BSB)

Int Cl (Ed.6): B60R 21/16, 21/20

Other: Online database: Derwent World Patents Index accessed via Questel

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	GB 2279046 A (PETRI AG) whole document	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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